Technology Strategy Team
Earth Science Tutorials

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Background

- **Utility of Tutorial**
  - **ESE scope (Enhanced understanding of Earth System)**
    - includes complex interrelated science research areas, measurements, sensors and technologies as well as diverse ways of making measurements -- LEO, GEO, airborne, in situ, balloons, field campaigns, radiosondes, sounding rockets, shuttle, etc.
  - **Science Driven Technology Needs**
    - to understand the interrelationships among the science areas, the measurements, the sensors that perform the measurements, and the technologies that enable better sensors and science
    - use this greater appreciation to facilitate the decision-making process, guide source selection and science policies, and proposal evaluation to do more with less
    - **TST Meeting March 2-3, 2000 Created ES WG**

- **Earth Science Tutorial Working Group**
  - **Identified needed subject matter expertise**
    - **Radar, Microwave, Lidar, Information Technology, etc.**
  - **Identified a number of existing Tutorials and scores of related URLs of excellent quality**
    - **NASA HQ and Centers, USRA, Air Force, DoE, NOAA, et al.**
      - **We have an extensive inventory of existing URLs**
        - » **NASA Educational Outreach extensive and excellent**
        - » **Focused Islands of information**
        - » **well-linked within area of technology Objective & Scope**
  - **Splinter group of ES WG met on June 7,2000 -- J. Duda, G. Prescott, & C.Munroe**
  - **Half-day workshop held at NASA HQ in August, 2000, to provide insight and produce an implementation plan**
  - **Feb 2001 HQ Web developer and graphic artist available**

Status

We have:

- **NASA Missions (current & Planned) on Internet**
  - **Using technologies**
  - **Making measurements**
  - **Addressing Earth Science mission needs**
- **Access to Many tutorials on Internet**
  - **Explaining phenomenology & terminology**
  - **physics absorption, emissivity, electromagnetic radiation**
  - **principles of radar, lidar, lasers, passive vs active sensors, radiometers, polarimeters, detectors**

We need to link the two to provide understanding of the basic physics, phenomenology, and principles in the context of technology & science needs

http://earth.nasa.gov/tutorial/tutorial-main.html

- That is, we have a bibliography of Web pages.

- **What Added Value can we provide?**
  - We can present a clear and consistent tutorial
    - That addresses the entire scope of the Earth Science Enterprise
      - LEO, GEO, airborne, in situ, balloons, surveys, etc.
    - That Clearly links science research areas/needs with needed measurements and associated sensors and technologies
    - That provides a Layered Approach
  - Synthesize the highest tutorial and provide links to more technical material

Measurements, Technologies and Science

- **Categorize Existing Sensors and Technologies**
  - Radiometers
  - Detectors
  - Polarimeters
- **Identify salient environment**
  - electromagnetic spectrum
  - electromagnetic properties of matter
  - dialectric constant
  - absorption characteristics
- **For example what is a radiometer?**
  - An instrument that quantitatively measures electromagnetic radiation
  - Collects measurements of electromagnetic radiation
  - Uses electromagnetic properties of matter to discern or characterize or identify properties of data
  - How does a radiometer work? What technology does it use? What is the state-of-the-art for that technology? What other technologies can be used? What measurements can be made? What science needs are addressed?
- **Link measurements with technologies and science needs**

Radiometers

- **Active Cavity Radiometer**
  - TSIM, CERES, SOLSTICE
- **Ultra Violet (UV) Radiometers**
  - TOMS (UV - Filter) , SBUV (UV - Filter) , XPS (UV - Filter) , OMPS (UV, Vis - Filter) , OMI (UV, Vis - Grating) , SAGE (UV, Vis - Grating)
- **Microwave/Radio Radiometers**
  - AMSU, HSB, AMSR, Poseidon, JASON, Sea Winds, MLS, Conical Microwave Imager/Sounder (CMIS)
- **Vis/IR Radiometers**
  - AIRS (Vis, IR - Grating) , ASTR (Vis, IR - Filter), GLAS (Active), HIRDLS (IR - Filter), MODIS (Vis, IR - Filter), MOPITT (IR - Filter),
  - TES (IR - FTS), HIS, HIRS (Vis, IR - Grating)
  - IASI (Vis, IR - FTS), Cross-track Infrared Sounder (CrIS) (Vis, IR - FTS)

Detectors

- **Imaging**
  - **ETM+**
  - **LIS**
  - **MISR**
  - **AVHRR**
  - **Visible/Infrared Imager Radiometer Suite (VIIRS)**
  - **Cross-track Infrared Sounder (CrIS)**
- **Field**
  - Magnetometer
- **Particle**
  - Space Environment Sensors
    - auroral boundary, auroral energy deposition, auroral imagery, electric field, electron density profile, geomagnetic field, in-situ plasma fluctuations, in-situ plasma temperatures, ionospheric scintillation, neutral density profile, medium energy charged particles, energetic ions, and supra-thermal to aurora energy particles.

Polarimeters

- **Earth Observing Scanning Polarimeter (EOSP)**
- **WindSat/Coriolis**
- **Conical Microwave Imager/Sounder (CMIS)**

Other

- ?
- ?
- ?

Help Wanted

- **Identify and Categorize Sensors and Technologies**
  - **radiometers, detectors, polarimeters**
  - **active vs passive**
  - **combinations and other**
- **Characterize Sensors in terms of phenomenology (science) and measurement technology**
  - **electromagnetic spectrum, emissivity, absorption, etc.**
- **Link measurements with technologies, missions, and science needs**
  - **to understand the interrelationships between the sensors that perform the measurements and the enabling technologies**
  - **to understand the interrelationships between the science areas and attendant measurements (and associated sensors)**
- **Provide information to Earth Science Tutorial Team and Webmaster to fill in the "gap" between Missions and Tutorials**